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09/559,504	04/27/2000	KEVIN G DONOHOE	11675.183	2135

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EXAMINER

GOUDREAU, GEORGE A

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 03/13/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09-559,504

Applicant(s)

Donohoe et al

Examiner

George Goudreau

Group Art Unit

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—The MAILING DATE of this communication appears on the cover sheet beneath the correspondence address—

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, such period shall, by default, expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- ☒ Responsive to communication(s) filed on 12-02' (ie, - papers # 6-8)
- ☐ This action is FINAL.
- ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- ☒ Claim(s) 1-49 is/are pending in the application.
- Of the above claim(s) 7, 20, 48 is/are withdrawn from consideration.
- ☐ Claim(s) _____ is/are allowed.
- ☒ Claim(s) 1-68-1619, 21-36, 39-43, 46-47, 49 is/are rejected.
- ☒ Claim(s) 17-18, 37-39, 44-45 is/are objected to.
- ☐ Claim(s) _____ are subject to restriction or election requirement

Application Papers

- ☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.
- ☐ The drawing(s) filed on _____ is/are objected to by the Examiner
- ☐ The specification is objected to by the Examiner.
- ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119 (a)-(d)

- ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119 (a)-(d).
- ☐ All ☐ Some* ☐ None of the:
- ☐ Certified copies of the priority documents have been received.
- ☐ Certified copies of the priority documents have been received in Application No. _____
- ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a))

*Certified copies not received: _____

Attachment(s)

- ☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 6
- ☒ Notice of Reference(s) Cited, PTO-892
- ☐ Notice of Draftsperson's Patent Drawing Review, PTO-948
- ☐ Interview Summary, PTO-413
- ☐ Notice of Informal Patent Application, PTO-152
- ☐ Other _____

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15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371© of this title before the invention thereof by the applicant for patent.

16. Claims 1-2, 4, 6, 9, 14-16, 19, 22, 29, 31-33, 35, 42-43, and 46 are rejected under 35 U.S.C. 102(e) as being anticipated by Tang et. al. (6,399,511).

Tang et. al. disclose two different etching processes for etching a damascene opening in ILD layers on a wafer using multi-step etching processes. The etching processes are conducted in a plasma etcher which has roof formed out of a Si anode which is heated to a temperature of at least 130 C. The wafer rests on a cathode which is surrounded by a Si ring which is heated to a temperature of at least 200 C. The Si anode, and the Si ring are use to getter free F in the plasma in order to increase the selectivity of the etching of a SiO₂ ILD layer (14) to an underlying Si₃N₄ etch stop layer (12).

The first etching process is comprised of the following steps:

-First, etch the top portion of the SiO₂ layer (14) in 80 sccm CHF₃/ 10 sccm C₂F₆/ 15 sccm CO/ 425 sccm Ar.; and

-Second, etch the bottom portion of the SiO₂ layer (14) in 80 sccm CHF₃/ 10 sccm C₂F₆/ 0 sccm Ar/ 425 sccm Ar.

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The C₂F₆ gas functions as a selectivity enhancing gas for improving the selectivity of the etching of the SiO₂ layer to the underlying Si₃N₄ layer while the CHF₃ gas functions as the principal etchant gas. The concentration of the C₂F₆ gas relative to the total flow of all etch gasses increases between step 1, and step 2 while the concentration of the CHF₃ gas relative to the total flow of all etch gasses decreases between step 1, and step 2.

The second etching process is comprised of the following steps:

-First, etch the top SiO₂ layer (20) in 90 sccm CHF₃/ 10 sccm CH₂F₂/ 0 sccm CO/
0 sccm C₄F₈;

-Second, etch the top Si₃N₄ layer (16) in 90 sccm CHF₃/ 10 sccm CH₂F₂/ 15 sccm CO/
0 sccm C₄F₈; and

-Third, etch the bottom SiO₂ layer (14) in 80 sccm CHF₃/ 0 sccm CH₂F₂/ 0 sccm CO/
10 sccm C₄F₈.

The C₄F₈ gas functions as a selectivity enhancing gas for improving the selectivity of the etching of the SiO₂ layer to the underlying Si₃N₄ layer while the CHF₃ gas functions as the principal etchant gas. The concentration of the C₄F₈ gas relative to the total flow of all etch gasses increases between step 1, and step 3 while the concentration of the CHF₃ gas relative to the total flow of all etch gasses decreases between step 1, and step 3.

This is discussed specifically in columns 5-14; and is discussed in general in columns 1-18.
This is shown in figures 15.

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17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

18. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

19. Claims 8, 10, 13, 21, 23-28, 30, 34, 36, 39-41, 47, and 49 rejected under 35 U.S.C. 103(a) as being unpatentable over Tang et. al. as applied in paragraph 16 above. Tang et. al. as applied in paragraph 16 above fail to disclose the following aspects of applicant's claimed invention:

- the specific etching process parameters which are claimed by the applicant;
- the specific usage of the etching process taught above to form a SAC with the specific structure which is claimed by the applicant; and
- the specific supply of the different etch gasses in pulses in the processes taught above

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It would have been obvious to one skilled in the art to supply the different etch gasses in pulses in the etching process taught above based upon the following. Tang et. al. teach that they conduct their multi-step etching process in the same plasma etcher simply by varying the flow of different etch gasses over time (i.e.- a type of pulsing of the etch gasses). Further, the pulsing of etch gasses is conventional or at least well known in the etching arts. (The examiner takes official notice in this regard.) Further, this simply represents the usage of an alternative, and at least equivalent means for supplying the different etch gasses to the etch chamber during the etching process to the specific usage of other such means.

It would have been obvious to one skilled in the art to employ the etching process taught above to form a SAC opening in a SiO₂ ILD in which the SiO₂ layer is etched down to Si₃N₄ spacers on the sidewalls of adjacent gates on a Si wafer based upon the following. It is conventional or at least well known in the semiconductor processing arts to form a SAC contact opening on a wafer in which an opening is etched through a SiO₂ ILD layer which covers pairs of adjacent gates on a wafer in which the gates sidewalls are covered with Si₃N₄ spacers which protect the gates from attack by the etchant during the etching process. (The examiner takes official notice in this regard.) Further, the specific usage of the etching process taught above to form the SAC opening simply represents the usage of an alternative, and at least equivalent means for conducting the etching process to the specific usage of other such means.

It would have been prima facie obvious to employ any of a variety of different etch process parameters in the etching process taught above including those which are specifically

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claimed by the applicant. These are all well known variables in the plasma etching art which are known to effect both the rate and quality of the plasma etching process. Further, the selection of particular values for these variables would not necessitate any undo experimentation which would be indicative of a showing of unexpected results.

Alternatively, it would have been obvious to one skilled in the art to employ the specific etching process parameters which are claimed by the applicant based upon In re Aller as cited below.

“Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” In re Aller, 220 F. 2d 454, 105 USPQ 233, 235 (CCPA).

Further, all of the specific process parameters which are claimed by the applicant are results effective variables whose values are known to effect both the rate, and the quality of the plasma etching process.

20. Claims 1-6, and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yang et. al. (6,403,488).

Yang et. al. disclose a process etching the opening for a SAC in a bulk dielectric layer (i.e.-SiO₂ or BPSG) to an underlying etch stop layer (Si₃N₄, TaN, AlN) using a plasma comprised of an etch gas (i.e.-C_xH_yF_z); a strained cyclic (hydro)fluorocarbon (i.e.- c-C₃F₅, c-C₃F₆, or c-C₄F₈); and a second (hydro)fluorocarbon (i.e.-C₂F₆, CF₄). The strained cyclic (hydro)fluorocarbon gas is used to increase the selectivity of the etching of the

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SiO₂ bulk layer to the underlying etch stop layer. This is discussed specifically in columns 2-5; and discussed in general in columns 1-8. Yang et. al. fail, however, to specifically disclose the following aspects of applicant's claimed invention:

- the specific etching process parameters which are claimed by the applicant;
- the specific usage of a plasma etchant comprised of CHF₃, c-C₄F₈, and C₂F₆ to conduct the etching process; and
- the specific usage of TiN or WN to form the etch stop layer

It would have been obvious to one skilled in the art to use a plasma comprised of CHF₃, c-C₄F₈, and C₂F₆ to conduct the etching process taught above based upon the following.

Yang et. al. teach that they employ an etch gas from each of three different groups of gasses. They further teach the equivalency in using any of the gasses in any of the groups to other gasses in the same group of gasses. Thus, it would have been obvious to one skilled in the art to use the specific combination of etch gasses which is claimed by the applicant to conduct their etching process.

It would have been obvious to one skilled in the art to use either WN or TiN as the etch stop in the etching process taught above based upon the following. Yang et. al. generically teach the usage of metal nitrides as etch stops in their etching process. The usage of WN, and TiN to form a metal nitride layer on a semiconductor wafer is conventional or at least well known in the semiconductor processing arts. (The examiner takes official notice in this regard.) Further, the specific usage of these metal nitrides simply involves the usage of an alternative, and at least

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equivalent means for forming the metal nitride etch stop layer in the process taught above to the specific usage of other such means.

It would have been prima facie obvious to employ any of a variety of different etch process parameters in the etching process taught above including those which are specifically claimed by the applicant. These are all well known variables in the plasma etching art which are known to effect both the rate and quality of the plasma etching process. Further, the selection of particular values for these variables would not necessitate any undue experimentation which would be indicative of a showing of unexpected results.

Alternatively, it would have been obvious to one skilled in the art to employ the specific etching process parameters which are claimed by the applicant based upon In re Aller as cited below.

“Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” In re Aller, 220 F. 2d 454, 105 USPQ 233, 235 (CCPA).

Further, all of the specific process parameters which are claimed by the applicant are results effective variables whose values are known to effect both the rate, and the quality of the plasma etching process.

21. Claims 17-18, 37-38, and 44-45 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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22. Applicant's arguments with respect to claims of record have been considered but are moot in view of the new ground(s) of rejection.

23. Claims 1-13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

-The scope of the preamble in claim 1, does not match the body of the claim. (No etching step is recited in the claim body as is recited in the claim preamble.); and

-The scope of the preamble in claim 13 does not match the body of the claim. (No step for forming an SAC opening is recited in the body of the claim as is recited in the claim preamble.)

24. This action will not be made final due to the new grounds of rejection.

25. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner George A. Goudreau whose telephone number is (703) -308-1915. The examiner can normally be reached on Monday through Friday from 9:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Examiner Gregory Mills, can be reached on (703) -308-1633. The appropriate fax phone number for the organization where this application or proceeding is assigned is (703) -306-3186.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) -308-0661.



George A. Goudreau/gag

Primary Examiner

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